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Taxonomic Paper

Eleven remarkable Diptera species, emerged from fallen aspens in Kivach Nature Reserve, Russian Karelia

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Abstract

Background

In 2016, saproxylic Diptera associated with aspen (*Populus tremula* L.) logs were studied in the Kivach Nature Reserve, Russian Karelia, using trunk emergence traps.

New information

Eleven rare species of Diptera (families Limoniidae, Scatopsidae, Axymyiidae, Mycetophilidae, Sciaridae, Platypezidae, Syrphidae and Clusiidae) with poorly known distribution and ecology were recorded. For each species, basic diagnostic characteristics were provided along with the information on microhabitats. An attempt was also undertaken to outline possible associations with wood-decaying macrofungi using nonparametric correlation.

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Keywords

Diptera, Russia, dead wood, aspen, wood-decaying macrofungi

Introduction

Saproxylic Diptera have never been specially studied in Russian Karelia, except for certain groups partly associated with wood-decaying fungi (Yakovlev 1988, Yakovlev 1993, Yakovlev 1995, Jakovlev 2011). Only a few works provide information on abundance and microhabitats for some rare or red-listed species associated with dead wood (Humala and Polevoi 2015, Siitonen et al. 1996, Polevoi and Salmela 2014, Yakovlev et al. 2000). In 2015, research which aimed to study the insect fauna on fallen logs of different tree species, was started. As a result, a number of remarkable species of Coleoptera, Hymenoptera and Diptera were recorded (Polevoi and Pilipenko 2016, Polevoi et al. 2017). In 2016, trapping was continued concentrating on fallen aspens with different degrees of decomposition. In total, 105 species of Diptera were collected, including a range of poorly known taxa Suppl. material 1. Here the most remarkable findings are presented.

Materials and methods

The trapping was undertaken in the Kivach Nature Reserve, Republic of Karelia. The biotope was *Oxalis acetosella-Vaccinium myrtillus* type spruce forest, over 150 years old (for details see Shorohova et al. 2016). Trunk emergence traps (Polevoi and Pilipenko 2016) were used as a collecting method. Fourteen traps were set on the fallen aspens, which had died from 1 to 16 years ago. The time since death was determined using dendrochronological methods (Shorohova et al. 2016). The traps were installed on 25 April 2016 and kept until 28 September 2016, with monthly checking. Diameter at the breast height, decay class (Shorohova et al. 2016) and the tree mortality mode (windthrow or windbreak) were recorded for each tree. The species composition of wood-decaying macromycetes was identified as well. The inventory of the fruitbodies was conducted in May, June, August and October, 2015 as well as in July and September, 2016. The presence-absence was recorded for all species on each log, counting one or several fruitbodies of a particular species on an individual dead tree as one occurrence. Remarkable Diptera species were recorded in 10 of the 14 installed traps (Table 1).

Series of images were captured with Leica MZ 9.5 and Leica DM1000 stereomicroscopes supplied with Leica DFC290 and LOMO MC-6.3 digital cameras. Images were then z-stacked using Helicon Focus software (http://www.heliconsoft.com/heliconsoft-products/helicon-focus).

Association with fungi was analysed using Pearson's non-parametric rank-order correlation coefficient (RS) calculated with PAST software (Hammer et al. 2001).

Table 1.

Occurrence of remarkable Diptera species and wood-decaying macromycetes on fallen aspens in Kivach Nature Reserve (DBH - diameter at breast height; WB - windbreak; WT - windthrow).

	A_1	**A_2**	**A_3**	**A_4**	**A_5**	**A_6**	**A_7**	**A_8**	**A_9**	**A_10**
Trunk parameters										
The time since tree death	9	16	10	7	10	5	8	1	4	6
Decay class	1	1	2	2	1	1	2	1	1	1
DBH (cm)	41.4	54.1	49.7	70.4	78.7	36.9	29.9	33.8	27.4	74.5
Tree mortality mode	WB	WT	WB	WB	WB	WB	WT	WB	WT	WB
Diptera (number of collected specimens)										
Atypophthalmus machidai Alexander	0	0	0	0	2	0	0	0	0	0
Discobola parvispinula Alexander	0	0	0	0	0	0	1	0	0	0
Gnophomyia acheron Alexander	0	0	0	6	2	1	0	0	0	0
Limonia badia Walker	0	1	0	1	0	0	0	0	0	223
Ectaetia subclavipes Krivosheina	16	0	7	295	18	3	0	0	1	1
Mesaxymyia kerteszi Duda	1	0	0	0	0	0	0	0	0	0
Impleta consorta Plassmann	0	0	1	0	0	0	0	0	0	0
Zygoneura bidens Mamaev	15	0	0	0	0	0	0	0	0	1
Agathomyia vernalis Shatalkin	0	0	0	0	6	0	4	0	0	0
Hammerschmidtia ingrica Stackelberg	0	0	0	4	0	0	0	0	0	0
Clusiodes tuomikoskii Mamajev	26	0	0	0	0	0	0	0	0	2
Fungi (presence/absence)										
Otidea onotica (Pers.) Fuckel	0	0	1	0	0	0	0	0	0	0
Peziza repanda Pers.	0	0	1	0	1	0	0	0	0	1
Scutellinia scutellata (L.) Lambotte	0	1	0	0	1	0	0	0	0	1
Pleurotus pulmonarius (Fr.) Quél	0	0	0	0	1	0	0	0	1	0
Armillaria cepistipes Velen.	1	0	1	1	0	1	1	0	0	0
Hericium cirrhatum (Pers.) Nikol.	1	0	1	0	0	0	0	0	0	0
Lentaria afflata (Lagget) Corner	0	0	0	1	0	1	0	0	0	1
Bjerkandera adusta (Willd.: Fr.) P. Karst.	1	1	1	0	1	0	1	0	1	1
Cerioporus leptocephalus (Jacq.) Zmitr.	0	0	0	0	1	0	0	0	0	0

Cerioporus squamosus (Huds.) Quél.	0	0	1	0	0	0	0	0	0	0
Fomes fomentarius (L.: Fr.) Fr.	0	0	0	1	0	0	1	0	0	0
Fomitopsis pinicola (Sw.: Fr.) P. Karst	0	0	0	0	1	0	1	0	0	0
Ganoderma applanatum (Pers.) Pat.	0	1	0	0	0	0	0	0	0	0
Hyphoderma setigerum (Fr.: Fr.) Donk	0	0	0	1	0	0	0	0	0	1
Inonotus obliquus (Pes.: Fr.) Pilát	0	0	0	0	0	1	0	0	0	0
Mycoacia fuscoatra (Fr.) Donk	0	0	1	0	0	0	0	0	0	0
Oxyporus corticola (Fr.) Ryvarden	1	0	1	1	1	1	1	0	0	1
Phellinus tremulae (Bondartsev) Bondartsev et Borisov	1	1	1	0	1	0	1	1	1	1
Royoporus badius (Pers.) A.B. De	0	0	0	0	1	0	0	0	0	0
Trametes ochracea (Pers.) Gilb. et Ryvarden	1	0	1	1	1	0	0	0	0	1
Trametes trogii Berk.	0	0	0	0	1	0	0	0	0	0
Xenasma rimicola (P. Karst.) Donk	0	0	0	0	0	0	1	0	0	0
Amphinema byssoides (Pers.: Fr.) J. Erikss.	0	1	0	0	1	0	1	0	0	1
Botryohypochnus isabellinus (Fr.) J. Erikss.	0	0	0	0	0	1	1	0	0	0
Chondrostereum purpureum (Pers.: Fr.) Pouzar	1	0	0	0	0	0	0	0	1	1
Coniophora arida (Fr.) P. Karst.	0	0	0	0	0	1	0	0	0	0
Coniophora olivacea (Fr.: Fr.) P. Karst.	0	0	0	0	0	1	0	0	0	0
Cylindrobasidium laeve (Pers.) Chamuris	0	0	0	0	0	0	0	1	0	0
Dichostereum boreale Pouzar	0	0	1	0	0	0	0	0	0	0
Kurtia argillacea (Bres.) Karasiński	0	0	0	0	0	0	1	0	0	0
Peniophora incarnata (Pers.) P. Karst.	0	0	0	0	0	0	0	0	0	1
Punctularia strigosozonata (Schwein.) Talbot	0	0	0	0	1	0	0	0	0	0
Resinicium bicolor (Alb. et Schwein.: Fr.) Parmasto	0	0	0	0	0	0	1	0	0	0
Scytinostroma galactinum (Fr.) Donk	0	0	1	0	0	1	0	0	0	0
Serpula himantioides (Fr.) P. Karst.	0	0	1	0	0	0	0	0	0	0
Subulicystidium longisporum (Pat.) Parmasto	0	0	0	1	0	0	0	0	0	0
Tomentella badia (Link) Stalpers	0	0	0	0	0	0	1	0	0	0
Tomentella bryophila (Pers.) M. J. Larsen	0	1	1	0	0	0	1	0	0	0
Tomentella cinerascens (P. Karst.) Höhn. et Litsch	0	0	0	0	0	1	0	0	0	0
Tomentella coerulea (Bres.) Höhn. et Litsch.	0	1	0	0	0	0	0	0	0	0

Tomentella crinalis (Fr.) M. J. Larsen	0	0	0	0	0	0	1	0	0	0
Tomentella lapida (Pers.) Stalpers	0	0	0	0	0	0	1	0	0	0
Tomentella stuposa (Link) Stalpers	0	0	1	0	0	0	0	0	0	0

Insect and fungal specimens are stored in the collection and herbarium of the Forest Research Institute, Petrozavodsk (FRIP).

Taxon treatments

Gnophomyia acheron Alexander, 1950

- Catalogue of Life http://www.catalogueoflife.org/annual-checklist/2017/details/species/id/b9c29484b800e7dffeeced4fa3b973bc

Material

a. country: Russia; stateProvince: Karelia; locality: Kivach Nature Reserve; verbatimLatitude: 62.281; verbatimLongitude: 33.967; verbatimCoordinateSystem: Decimal degrees; verbatimSRS: WGS84; samplingProtocol: Trunk emergence trap; eventDate: 2016-05-26/06-2; sex: 7 males, 2 females; recordedBy: A. Polevoi; identifiedBy: A. Polevoi; institutionCode: FRIP

Diagnosis

Medium sized dark species, distinguished from other *Gnophomyia* by the structure of male and female genitalia (Fig. 1; see also Hancock (2008), fig. 6, 10).

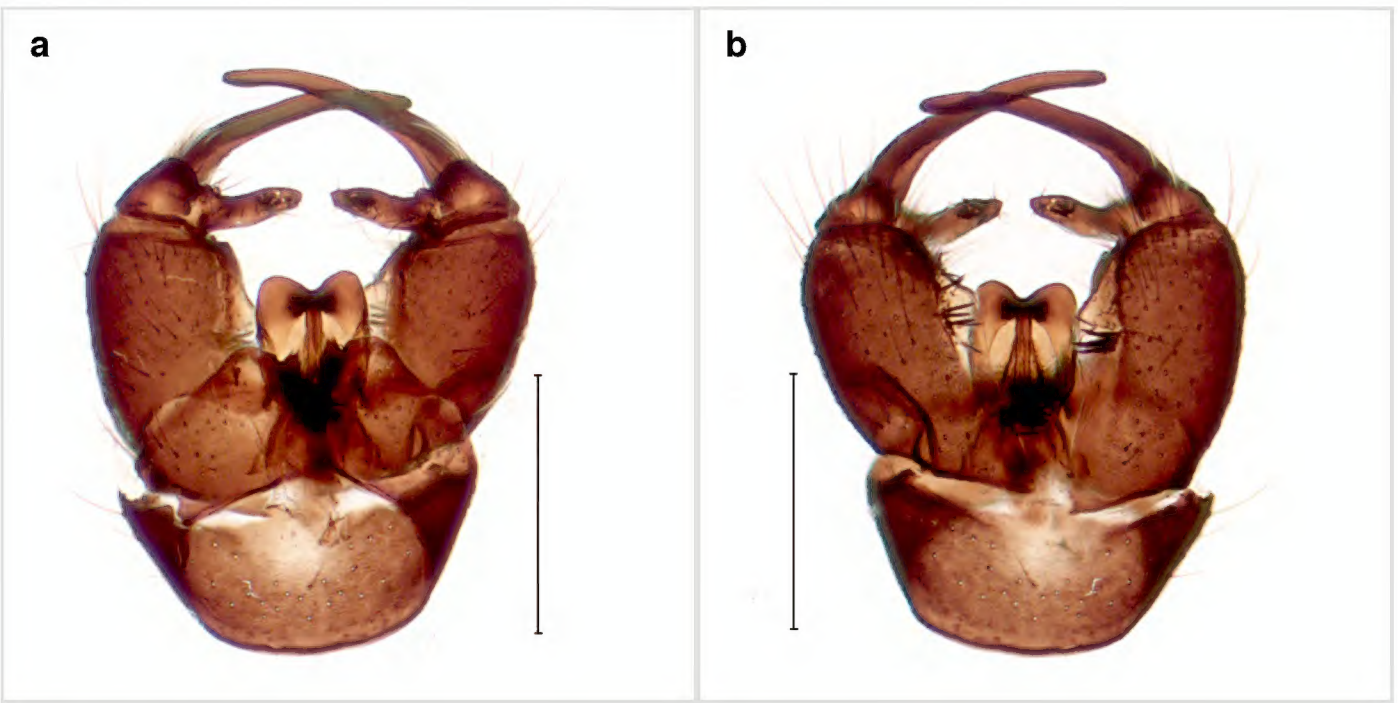

Figure 1.

Gnophomyia acheron Alexander, male genitalia. Scale bar: 0.5 mm.

a: Dorsal view doi

b: Ventral view doi

Distribution

Palaearctic. Only recently discovered in Finland and Russian Karelia (Polevoi and Salmela 2014, Starý and Salmela 2004).

Ecology

Saproxylic species, associated with different deciduous trees (Krivosheina 2008). In Finland and Karelia, so far collected exclusively on aspen (Hancock 2008, Halme et al. 2012). According to the authors' data, this species prefers huge wind-broken aspens with a diameter over 70 cm, fallen 7 years ago (Table 1). It favoured the trunks colonised by *Lentaria afflata* (RS=0.56, $P<0.05$) and *Subulicystidium longisporum* (RS=0.62, $P<0.05$), but seemed to avoid those decayed by *Phellinus tremulae* (RS=-0.56, $P<0.05$).

Conservation

Red-listed in Finland, category VU (Penttinen et al. 2010).

Atypophthalmus (*Microlimonia*) *machidai* (Alexander, 1921)

- Catalogue of Life http://www.catalogueoflife.org/annual-checklist/2017/details/species/id/d9bb1dfccd0cc6dea751bed18d0696c0

Material

a. country: Russia; stateProvince: Karelia; locality: Kivach Nature Reserve; verbatimLatitude: 62.281; verbatimLongitude: 33.967; verbatimCoordinateSystem: Decimal degrees; verbatimSRS: WGS84; samplingProtocol: Trunk emergence trap; eventDate: 2016-06-23/07-21; sex: 1 male, 1 female; recordedBy: A. Polevoi; identifiedBy: A. Polevoi; institutionCode: FRIP

Diagnosis

Medium sized species with peculiar male genitalia (Fig. 2), see also (Podenas and Gelhaus 2007, fig. 51)

Distribution

Palaearctic and Oriental regions (Oosterbroek 2017). Karelian record is the northernmost one. Closest locations are in Poland, Lithuania and Moscow province in Russia.

Ecology

Saproxylic species. Larvae develop under the bark of various trees (Krivosheina 2010). This species was collected from a wind-broken aspen, colonised by 13 species of macrofungi (Table 1).

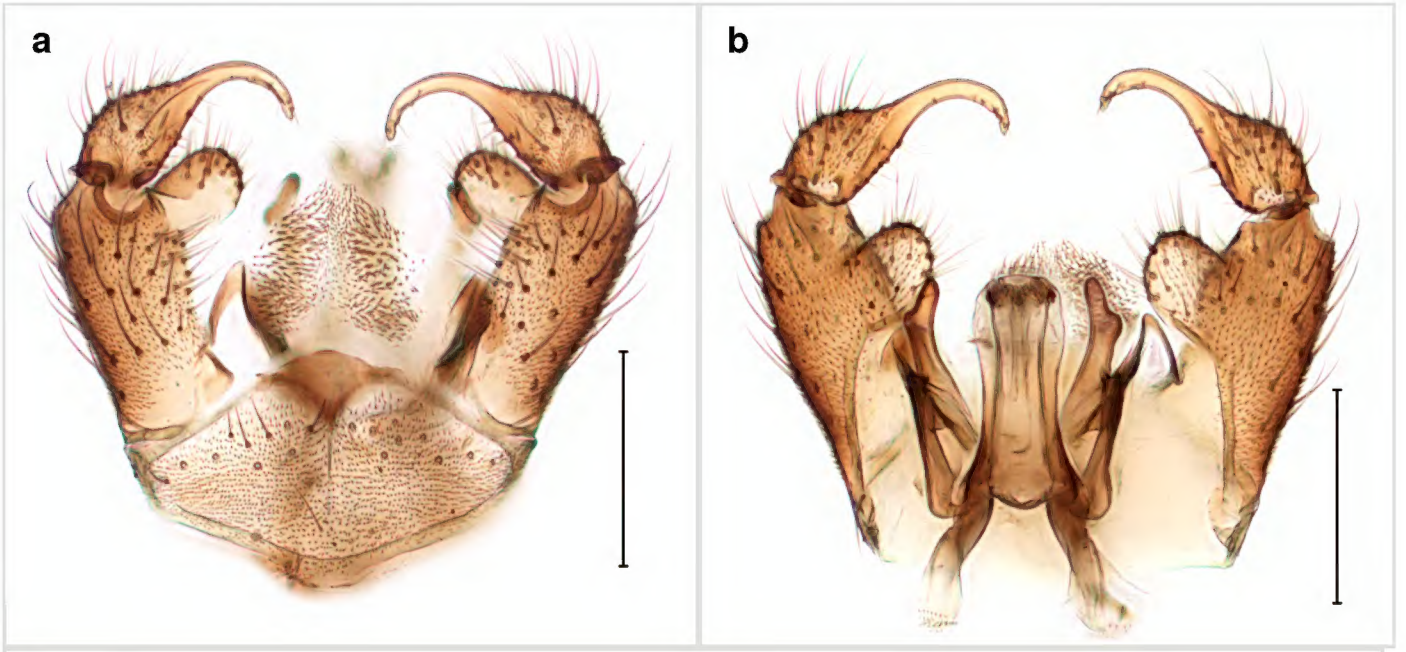

Figure 2.

Atypophthalmus machidai (Alexander), male genitalia. Scale bar: 0.2 mm.

a: Dorsal view. doi

b: Ventral view. doi

Discobola parvispinula (Alexander, 1947)

- Catalogue of Life http://www.catalogueoflife.org/annual-checklist/2017/details/species/id/8bb2ed786a6d52e53c05e998f1957b9b

Material

a. country: Russia; stateProvince: Karelia; locality: Kivach Nature Reserve; verbatimLatitude: 62.281; verbatimLongitude: 33.967; verbatimCoordinateSystem: Decimal degrees; verbatimSRS: WGS84; samplingProtocol: Trunk emergence trap; eventDate: 2016-07-21/08-19; sex: 1 male; recordedBy: A. Polevoi; identifiedBy: A. Polevoi; institutionCode: FRIP

Diagnosis

Distinguished from other *Discobola* by more heavily marked wings and the structure of the male genitalia (Fig. 3), see also (Starý 1974, fig. 5, 6) .

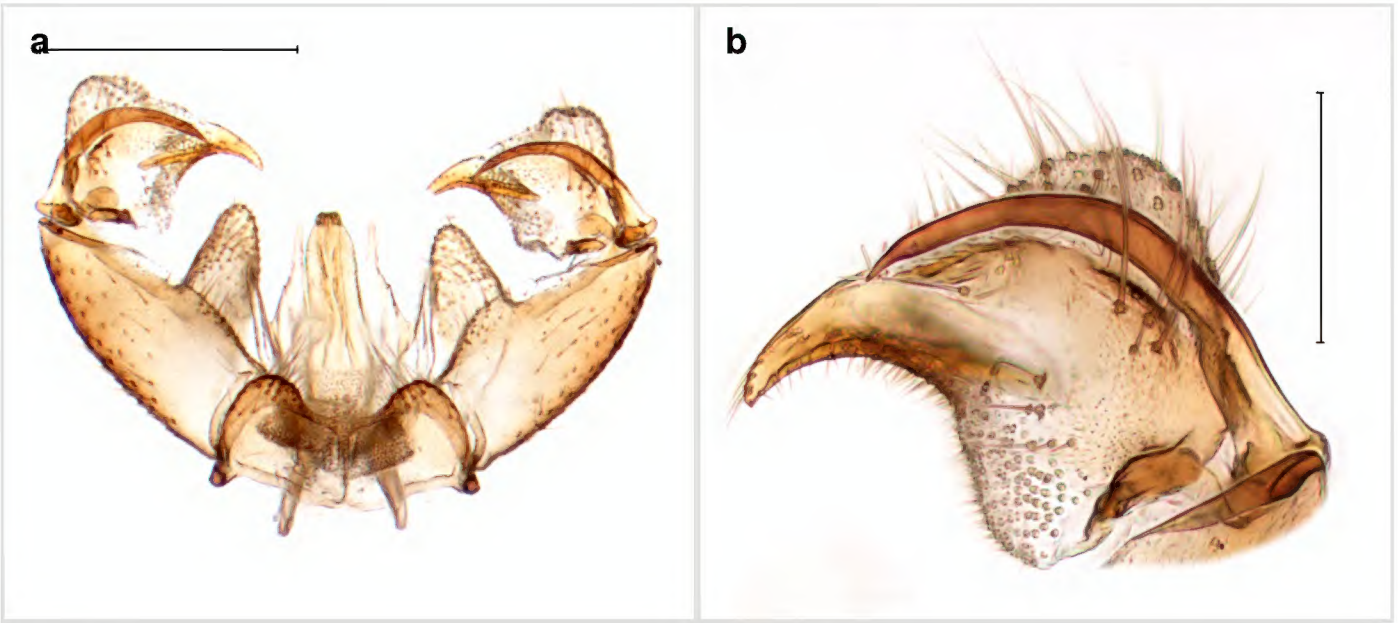

Figure 3.

Discobola parvispinula (Alexander), male genitalia.

a: Dorsal view. Scale bar: 0.5 mm. doi

b: Gonostylus. Scale bar: 0.2 mm. doi

Distribution

Palaearctic (Oosterbroek 2017). Karelian record is the northernmost one. Closest locations are in Poland, Lithuania and the Republic of Bashkortostan in Russia.

Ecology

Poorly known, though associations with dead wood and wood-destroying fungi were reported (Ševčík 2006, Wiedenska 2007). This species was collected from a windthrown aspen, colonised by 15 species of macrofungi (Table 1).

Limonia badia (Walker, 1848)

- Catalogue of Life http://www.catalogueoflife.org/annual-checklist/2017/details/species/id/62f9e86b98f925526e31a0a3ac4c380a

Materials

a. country: Russia; stateProvince: Karelia; locality: Kivach Nature Reserve; verbatimLatitude: 62.281; verbatimLongitude: 33.967; verbatimCoordinateSystem: Decimal degrees; verbatimSRS: WGS84; samplingProtocol: Trunk emergence trap; eventDate: 2016-07-21/08-1; sex: 31 males, 13 females; recordedBy: A. Polevoi; identifiedBy: A. Polevoi; institutionCode: FRIP

b. country: Russia; stateProvince: Karelia; locality: Kivach Nature Reserve; verbatimLatitude: 62.281; verbatimLongitude: 33.967; verbatimCoordinateSystem: Decimal degrees; verbatimSRS: WGS84; samplingProtocol: Trunk emergence trap; eventDate: 2016-08-19/09-28; sex: 95 males, 86 females; recordedBy: A. Polevoi; identifiedBy: A. Polevoi; institutionCode: FRIP

Diagnosis

Distinguished from other *Limonia* by the structure of the male genitalia (Fig. 4) as well as wing pattern and the shape of the tarsal claws (Starý and Salmela 2004, fig. 1, 2).

Figure 4. doi

Limonia badia (Walker), male genitalia, dorsal view. Scale bar: 0.5 mm.

Distribution

Holarctic species, recently discovered in Finland (Starý and Salmela 2004) and Russian Karelia (Polevoi and Salmela 2014).

Ecology

Saproxylic species, associated with dead aspen wood (Halme et al. 2012). According to the authors' data, this species prefers wind-broken aspens with a diameter over 50 cm, fallen 6 years ago Table 1. It favoured the trunks colonised by *Hyphoderma setigerum* (RS=0.81, P<0.01), *Peniophora incarnata* (RS=0.62, P<0.05), *Scutellinia scutellata* and *Lentaria afflata* (RS=0.59, P<0.05).

Conservation

Red-listed in Finland, category NT (Penttinen et al. 2010).

Ectaetia subclavipes Krivosheina, 2002

- Catalogue of Life http://www.catalogueoflife.org/annual-checklist/2017/details/species/id/4d727f0ceba0ba5043f0f48b85d53d30

Materials

a. country: Russia; stateProvince: Karelia; locality: Kivach Nature Reserve; verbatimLatitude: 62.281; verbatimLongitude: 33.967; verbatimCoordinateSystem: Decimal degrees; verbatimSRS: WGS84; samplingProtocol: Trunk emergence trap; eventDate: 2016-05-26/06-23; sex: 98 males, 135 females; recordedBy: A. Polevoi; identifiedBy: A. Polevoi; institutionCode: FRIP

b. country: Russia; stateProvince: Karelia; locality: Kivach Nature Reserve; verbatimLatitude: 62.281; verbatimLongitude: 33.967; verbatimCoordinateSystem: Decimal degrees; verbatimSRS: WGS84; samplingProtocol: Trunk emergence trap; eventDate: 2016-06-23/07-21; sex: 11 males, 95 females; recordedBy: A. Polevoi; identifiedBy: A. Polevoi; institutionCode: FRIP

c. country: Russia; stateProvince: Karelia; locality: Kivach Nature Reserve; verbatimLatitude: 62.281; verbatimLongitude: 33.967; verbatimCoordinateSystem: Decimal degrees; verbatimSRS: WGS84; samplingProtocol: Trunk emergence trap; eventDate: 2016-07-21/08-19; sex: 1 male, 1 female; recordedBy: A. Polevoi; identifiedBy: A. Polevoi; institutionCode: FRIP

Diagnosis

Flies of the genus *Ectaetia* have peculiar wing venation, namely the vein M partly fused with R_{4+5} (Fig. 5). *Ectaetia subclavipes* is distinguished from congeners by the structure of the male genitalia (Fig. 6; see also Krivosheina (2002), fig. 28-30).

Figure 5. doi

Ectaetia subclavipes Krivosheina, habitus.

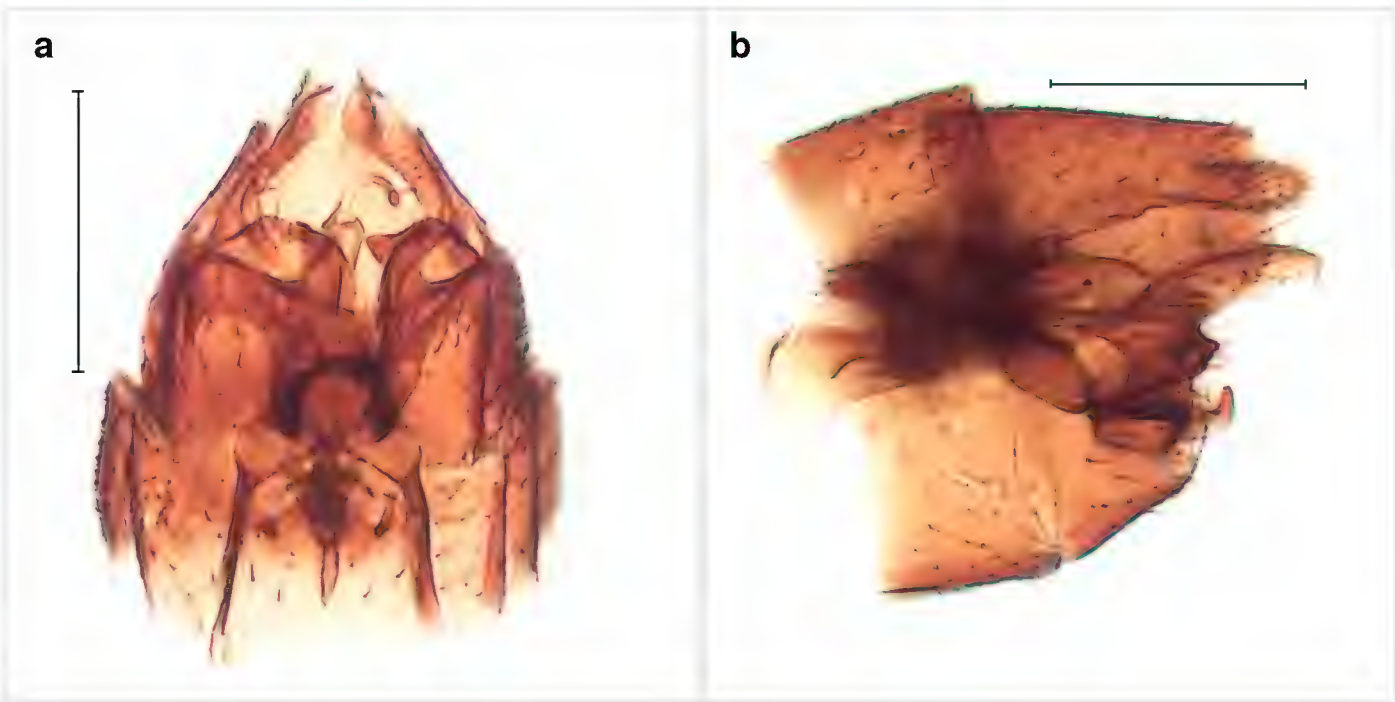

Figure 6.

Ectaetia subclavipes Krivosheina, male genitalia. Scale bar: 0.2 mm.

a: Ventral view. doi

b: Lateral view. doi

Distribution

East Russia: Khabarovsk region, Amur province, Tuva, Sakhalin island (Krivosheina 2002). First record for Europe.

Ecology

Larvae develop under the bark of aspen and poplar (Krivosheina 2002). According to the authors' data, the species prefers huge wind-broken aspens (diameter 70 cm. and more) fallen 7-10 years ago Table 1. It favoured the trunks colonised by *Oxyporus corticola* (RS=0.69, P<0.01), *Trametes ochracea* (RS=0.63, P<0.05) and *Hyphoderma setigerum* (RS=0.56, P<0.05).

Mesaxymyia kerteszi (Duda, 1930)

- Catalogue of Life http://www.catalogueoflife.org/annual-checklist/2017/details/species/id/8e5f999d7fd9b092a5b50a3bdf7fef17

Material

a. country: Russia; stateProvince: Karelia; locality: Kivach Nature Reserve; verbatimLatitude: 62.281; verbatimLongitude: 33.967; verbatimCoordinateSystem: Decimal degrees; verbatimSRS: WGS84; samplingProtocol: Trunk emergence trap; eventDate: 2016-05-26/06-2; sex: 1 female; recordedBy: A. Polevoi; identifiedBy: A. Polevoi; institutionCode: FRIP

Diagnosis

Medium-sized flies with darkened wings (Fig. 7).

Figure 7. doi

Mesaxymyia kerteszi (Duda), female habitus. Scale bar: 2 mm.

Distribution

Europe. Known by a few records from the European part of Russia, Ukraine and Slovakia (Humala and Polevoi 2009, Jakovlev and Polevoi 1997, Martinovský and Roháček 1993).

Ecology

Poorly known. Larvae were collected from spruce wood (Mamaev and Krivosheina 1966) and adults found sitting on very damp fir logs (Martinovský and Roháček 1993). According to Krivosheina (1991), larvae of Axymyiidae may colonise newly fallen trunks and stay there for several years. This species was collected from a wind-broken aspen, colonised by 7 species of macrofungi Table 1.

Impleta consorta Plassmann, 1978

- Catalogue of Life http://www.catalogueoflife.org/annual-checklist/2017/details/species/id/0e3b60c045c2ad149fb1c41f3bdb2b06

Material

a. country: Russia; stateProvince: Karelia; locality: Kivach Nature Reserve; verbatimLatitude: 62.281; verbatimLongitude: 33.967; verbatimCoordinateSystem: Decimal degrees; verbatimSRS: WGS84; samplingProtocol: Trunk emergence trap; eventDate: 2016-07-21/08-1; sex: 1 male,; recordedBy: A. Polevoi; identifiedBy: A. Polevoi; institutionCode: FRIP

Diagnosis

Small gnat, distinguished by wing venation (see http://sciaroidea.info/taxonomy/42011) and characters of the male genitalia (Fig. 8; see also Matile (1983), fig. 1).

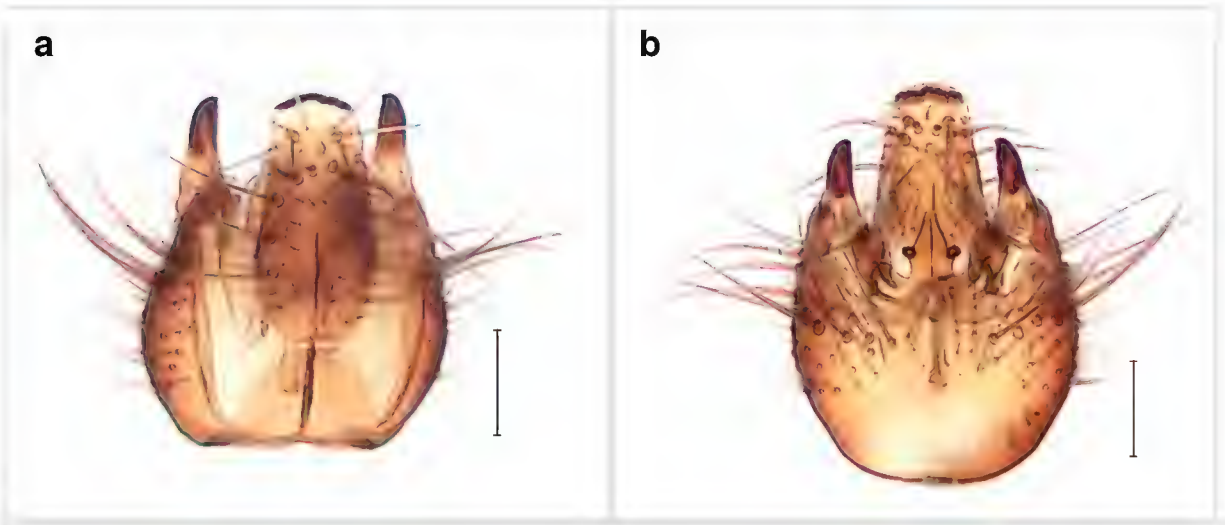

Figure 8.

Impleta consorta Plassmann, male genitalia. Scale bar: 0.1 mm

a: Dorsal view. doi

b: Ventral view. doi

Distribution

Palaearctic. Known by a few specimens from Sweden, Poland, Finland and Norway (Kurina 2003, J. Kjærandsen pers. comm.). Recently reported from East Russia (Polevoi and Barkalov 2017).

Ecology

Poorly known. Some specimens were caught with light traps (Plassmann 1980, Kurina 2003, J. Kjærandsen pers. comm.). This species was collected from a wind-broken aspen, colonised by 15 species of macrofungi Table 1.

Conservation

Red-listed in Finland, category NT (Penttinen et al. 2010).

Zygoneura (*Pharetratula*) *bidens* (Mamaev, 1968)

- Catalogue of Life http://www.catalogueoflife.org/annual-checklist/2017/details/species/id/237e139b55f7d5dd99863fe5e71a4491

Materials

a. country: Russia; stateProvince: Karelia; locality: Kivach Nature Reserve; verbatimLatitude: 62.281; verbatimLongitude: 33.967; verbatimCoordinateSystem: Decimal degrees; verbatimSRS: WGS84; samplingProtocol: Trunk emergence trap; eventDate:

2016-05-26/06-23; sex: 1 male; recordedBy: A. Polevoi; identifiedBy: A. Polevoi; institutionCode: FRIP

b. country: Russia; stateProvince: Karelia; locality: Kivach Nature Reserve; verbatimLatitude: 62.281; verbatimLongitude: 33.967; verbatimCoordinateSystem: Decimal degrees; verbatimSRS: WGS84; samplingProtocol: Trunk emergence trap; eventDate: 2016-06-23/07-21; sex: 1 male; recordedBy: A. Polevoi; identifiedBy: A. Polevoi; institutionCode: FRIP

c. country: Russia; stateProvince: Karelia; locality: Kivach Nature Reserve; verbatimLatitude: 62.281; verbatimLongitude: 33.967; verbatimCoordinateSystem: Decimal degrees; verbatimSRS: WGS84; samplingProtocol: Trunk emergence trap; eventDate: 2016-07-21/08-19; sex: 13 males; recordedBy: A. Polevoi; identifiedBy: A. Polevoi; institutionCode: FRIP

d. country: Russia; stateProvince: Karelia; locality: Kivach Nature Reserve; verbatimLatitude: 62.281; verbatimLongitude: 33.967; verbatimCoordinateSystem: Decimal degrees; verbatimSRS: WGS84; samplingProtocol: Trunk emergence trap; eventDate: 2016-08-19/09-28; sex: 1 male; recordedBy: A. Polevoi; identifiedBy: A. Polevoi; institutionCode: FRIP

Diagnosis

Gnats of the genus *Zygoneura* are distinguished from other Sciaridae by widely curved fork of wing vein M and long neck of flagellomeres (Fig. 9a). *Zygoneura bidens* can be recognised by the two dark spines on a shared lobe in the middle of gonostylus (Fig. 9b; see also Shin et al. (2014), fig. 1: A, B).

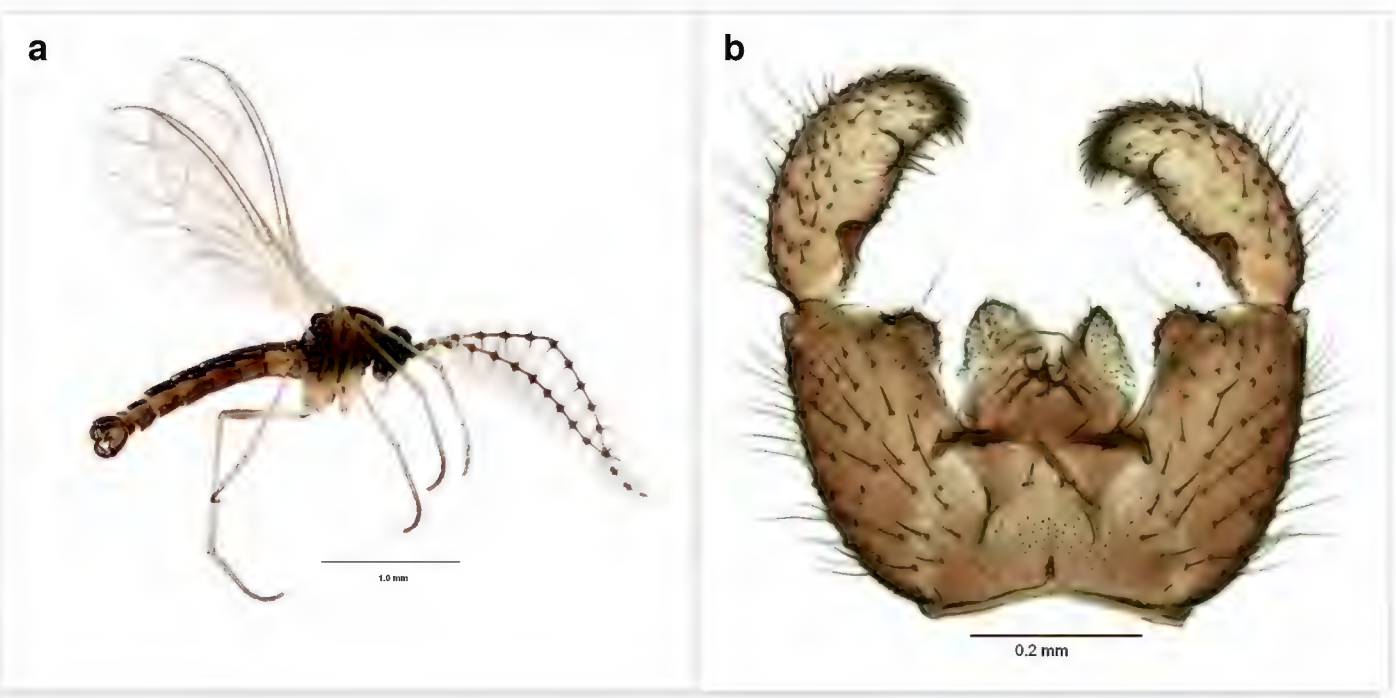

Figure 9.

Zygoneura bidens (Mamaev), male.

a: Habitus. doi

b: Genitalia, ventral view. doi

Distribution

Palaearctic: Slovakia (Rudzinski and Ševčík 2012), China, Korea and the Russian Far East (Shin et al. 2014).

Ecology

Evidently saproxylic as other species of the subgenus *Pharetratula*. In Korea, collected at a shiitake farm with oak trunks used as a substrate for shiitake culture (Shin et al. 2014). According to the authors' data, the species prefers wind-broken aspens with a mean diameter of ca. 40 cm and having died 9 years ago Table 1. It favoured the trunks colonised by *Peniophora incarnata* (RS=0.61, P<0.05).

Agathomyia vernalis Shatalkin, 1981

- Catalogue of Life http://www.catalogueoflife.org/annual-checklist/2017/details/species/id/749f7ac63c3cea4cc9f79d6f4d701a96

Material

a. country: Russia; stateProvince: Karelia; locality: Kivach Nature Reserve; verbatimLatitude: 62.281; verbatimLongitude: 33.967; verbatimCoordinateSystem: Decimal degrees; verbatimSRS: WGS84; samplingProtocol: Trunk emergence trap; eventDate: 2016-04-25/05-26; sex: 2 males, 8 females; recordedBy: A. Polevoi; identifiedBy: A. Polevoi; institutionCode: FRIP

Diagnosis

Males of *A. vernalis* are distinguished from congeners by several morphological characters, including the structure of the male genitalia (Fig. 10; see also Chandler (2001), Fig. 107-109), while females are recognised by peculiar abdominal marking (Chandler 2001, fig. 110, 111).

Figure 10. doi

Agathomyia vernalis Shatalkin, male genitalia, lateral view. Scale bar: 0.2 mm.

Distribution

Europe: Moscow province of Russia, Czech and Slovak Republics, Switzerland (Chandler 2001), Finland (Ståhls and Kahanpää 2006) and Romania (Tkoč and Roháček 2014).

Ecology

Virtually unknown. Other *Agathomyia* species assumed to develop internally in polypore fungi (Chandler 2001). In the Czech Republic, adults were registered in pyramidal (emergence) traps (Tkoč and Barták 2013). This species was collected from aspens fallen 8-10 years ago. The species did not show any preferences either to the trunk size or tree mortality mode (windfall vs. windbreak) Table 1. Its occurrence positively correlated with the following fungi: *Fomitopsis pinicola* (RS=0.99, P<0.01), *Cerioporus leptocephalus*, *Royoporus badius*, *Trametes trogii*, *Punctularia strigosozonata* (RS=0.73, P<0.01), *Xenasma rimicola*, *Kurtia argillacea*, *Resinicium bicolor*, *Tomentella badia*, *T. crinalis* and *T. lapida* (RS=0.61, P<0.05).

Conservation

Red-listed in Czech Republic, category EN (Farkac et al. 2005).

Hammerschmidtia ingrica Stackelberg, 1952

- Fauna Europaea https://fauna-eu.org/cdm_dataportal/taxon/197de867-9c6b-4f01-9aa3-410813b7d47f

Material

a. country: Russia; stateProvince: Karelia; locality: Kivach Nature Reserve; verbatimLatitude: 62.281; verbatimLongitude: 33.967; verbatimCoordinateSystem: Decimal degrees; verbatimSRS: WGS84; samplingProtocol: Trunk emergence trap; eventDate: 2016-04-25/05-26; sex: 3 males, 1 females; recordedBy: A. Polevoi; identifiedBy: A. Polevoi; institutionCode: FRIP

Diagnosis

Easily distinguished from more common *H. ferruginea* Fallén by smaller body size and short feathering of the arista (Fig. 11, see also Kerppola (2011), fig. 2-4).

Distribution

Palaearctic. Few specimens are known from Finland and Leningrad province of Russia (Kerppola 2011). In East Russia, recorded from the republic of Tyva to Primorje region (Krivosheina 2003).

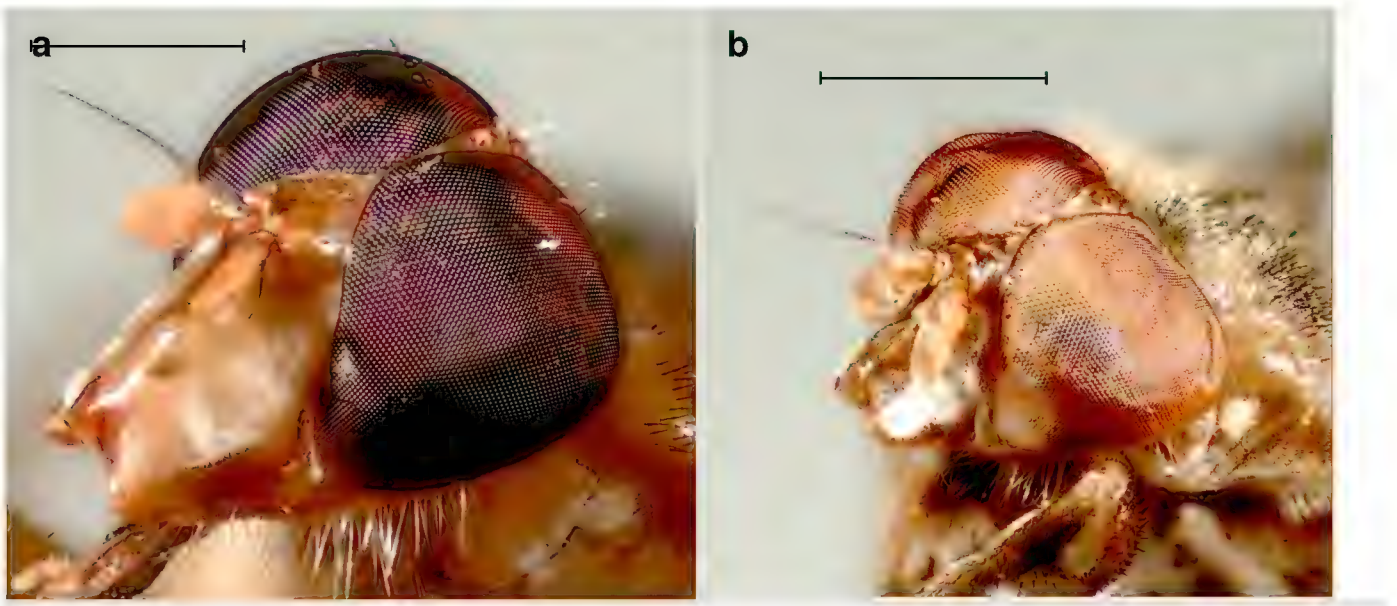

Figure 11.

Head of *Hammerschmidtia* spp. Scale bar: 2 mm.

a: *H. ferruginea* Fallén. doi

b: *H. ingrica* Stackelberg. doi

Ecology

Saproxylic species, associated with deciduous trees (Krivosheina 2003). This fly was collected from a wind-broken aspen, colonised by 7 species of macrofungi Table 1.

Conservation

Red-listed in Leningrad province of Russia (Krivokhatsky and Kuznetsov 2002).

Clusiodes tuomikoskii Mamaev, 1974

- Catalogue of Life http://www.catalogueoflife.org/annual-checklist/2017/details/species/id/56f936b25a743fb51421c5ddb9a880a0

Material

a. country: Russia; stateProvince: Karelia; locality: Kivach Nature Reserve; verbatimLatitude: 62.281; verbatimLongitude: 33.967; verbatimCoordinateSystem: Decimal degrees; verbatimSRS: WGS84; samplingProtocol: Trunk emergence trap; eventDate: 2016-04-25/05-26; sex: 14 males, 14 females; recordedBy: A. Polevoi; identifiedBy: A. Polevoi; institutionCode: FRIP

Diagnosis

The only representative of the genus *Clusiodes* with no darkening along the costal vein and entirely black scutum (Fig. 12). Male surstylus figured by Mamaev (1974), fig. 1:3 and Lonsdale and Marshall (2007), fig. 41.

Figure 12. doi

Clusiodes tuomikoskii Mamaev, male habitus.

Distribution

Known only by the type specimens from East Russia, Primorje region (Lonsdale and Marshall 2007, Mamaev 1974). First record for Europe.

Ecology

Unknown, but most probably similar to other species of *Clusiodes*, which develop in dead wood in an advanced state of decay, preferring fallen bark-covered trunks or stumps (Rotheray and Horsfield 2013). According to the authors' data, this species prefers wind-broken aspens of average diameter (ca. 40 cm) fallen 9 years ago (Table 1). It favoured the trunks colonised by *Peniophora incarnata* (RS=0.61, P<0.05).

Discussion

Trunk emergence traps have some benefits in comparison with other methods traditionally used for collection of wood-living Coleoptera and Diptera (Alinvi et al. 2006, Halme et al. 2012). They, however fail in some cases (e.g. when larvae need to migrate to the soil for pupation) and usually cannot provide exact information about microhabitat preferences (Økland 1999). These traps were shown to be effective in detecting rather diverse insect communities, including a range of rare and otherwise remarkable species, which are difficult to find using commonly used techniques (Polevoi et al. 2017). This study once more demonstrates the effectiveness of the method and also shows the importance of large dead aspens for supporting diverse saproxylic insect communities. It is realised that indirect association of Diptera species with certain trunk parameters or fungi, e.g. correlation, may be questionable because of the relatively small number of replicates.

However, in case of species with poorly known biology, such information may be of great importance. Initial knowledge about species preferences may help to outline directions for future studies and conservation measures.

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Author contributions

Alexei Polevoi collected and identified Diptera and wrote the text. Anna Ruokolainen collected and identified fungi. Ekaterina Shorohova participated in the study design, fieldwork and writing the manuscript.

References

- Alinvi O, Ball JP, Danell K, Hjältén J, Pettersson RB (2006) Sampling saproxylic beetle assemblages in dead wood logs: comparing window and eclector traps to traditional bark sieving and a refinement. Journal of Insect Conservation 11 (2): 99-112. https://doi.org/10.1007/s10841-006-9012-2
- Chandler PJ (2001) The flat-footed flies (Diptera: Opetiidae and Platypezidae) of Europe. Fauna Entomologica Scandinavica. Volume 36. Brill, Leiden-Boston-Köln, 276 pp.
- Farkac J, Král D, Škorpík M (Eds) (2005) List of threatened species in the Czech Republic. Invertebrates. Agentura ochrany prírody a krajiny CR, Praha, 760 pp. URL: http://portal.nature.cz/publik_syst/files/RL_2005_bezobr.pdf
- Halme P, Vartija N, Salmela J, Penttinen J, Norros V (2012) High within- and between-trunk variation in the nematoceran (Diptera) community and its physical environment in decaying aspen trunks. Insect Conservation and Diversity 6 (4): 502-512. https://doi.org/10.1111/icad.12007
- Hammer Ø, Harper DA, Ryan PD (2001) PAST: Palaeontological statistics software package for education and data analysis. Palaeontologica Electronica 4: 1-9. URL: http://palaeo-electronica.org/2001_1/past/issue1_01.htm
- Hancock EG (2008) Larval habitat preferences in Palaearctic Gnophomyia (Diptera, Limoniidae) with a key to adults. Sahlbergia 14: 13-16.
- Humala AE, Polevoi AV (2009) On the insect fauna of south-east Karelia. Transactions of the Karelian Research Centre of the Russian Academy of Sciences. Biogeography Series 9 (4): 53-75. [In Russian].

- Humala AE, Polevoi AV (2015) Records of rare and noteworthy insect species (Insecta) in the Republic of Karelia. Transactions of the Karelian Research Centre of the Russian Academy of Sciences. Biogeography Series 6: 19-46. [In Russian]. https://doi.org/10.17076/bg30
- Jakovlev EB, Polevoi AV (1997) On the fauna of Diptera Nematocera of Kivach Nature Reserve. In: Kravchenko AV (Ed.) Flora and Fauna of the Nature Protected Territories of Karelia. Volume 1. Karelian Research Centre RAS, Petrozavodsk, 23 pp. [In Russian].
- Jakovlev JB (2011) Fungus gnats (Diptera: Sciaroidea) associated with dead wood and wood growing fungi: new rearing data from Finland and Russian Karelia and general analysis of known larval microhabitats in Europe. Entomologica Fennica 22: 157-189.
- Kerppola S (2011) *Hammerschmidtia ingrica* Stackelberg, 1952 – Inkerinmahlanen Suomesta (Diptera, Syrphidae). Sahlbergia 17: 2-4. [In Finnish].
- Krivokhatsky VA, Kuznetsov SY (2002) *Hammerschmidtia ingrica* Stack. In: Noskov GA (Ed.) Red Data Book of Nature of the Leningrad Region. Animals. Volume 3. Mir i Sem'ya, St. Petersburg, 2 pp.
- Krivosheina MG (2003) A review of flower-flies of the genus *Hammerschmidtia* of Russia, with description of larva of *H. ingrica* (Diptera, Syrphidae). Entomological Review 83 (3): 361-367.
- Krivosheina MG (2008) Biology of xylobiont larvae of limoniid flies of the genus *Gnophomyia* (Diptera, Limoniidae) with description of immature stages. Entomological Review 88: 793-807. https://doi.org/10.1134/S001387380807004X
- Krivosheina NP (1991) Relations between wood-inhabiting insects and fungi. In: Baranchikov YN, Mattson WJ, Hain FP, Payne TL (Eds) Forest Insect Guilds: Patterns of Interaction with Host Tree. U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station, Randor, 11 pp.
- Krivosheina NP (2002) A review of palaearctic species of the genus *Ectaetia* Enderlein, 1912 (Diptera, Scatopsidae) with description of new species. Entomologicheskoe Obozrenie 81 (3): 726-736. [In Russian].
- Krivosheina NP (2010) On the larval morphology and ecology of the limoniid *Microlimonia machidai* (Diptera, Limoniidae). Entomological Review 90 (1): 135-140. https://doi.org/10.1134/s0013873810010124
- Kurina O (2003) Notes on fungus gnats from the Lemmenlaakso area in southern Finland, including six species new to the Finnish list (Diptera: Sciaroidea excl. Sciaridae). Sahlbergia 8: 84-88.
- Lonsdale O, Marshall SA (2007) Redefinition of the genera *Clusiodes* and *Hendelia* (Diptera: Clusiidae: Clusiodinae), with a review of Clusiodes . Studia dipterologica 14: 117-159.
- Mamaev B, Krivosheina N (1966) New data on the taxonomy and biology of Diptera of the family Axymyiidae . Entomologicheskoe Obozrenie 45 (1): 168-180.
- Mamaev B (1974) New species of druid flies (Diptera, Clusiidae) from South Primorje. In: Mamaev B (Ed.) Insects Destroying Wood in Forest Biocenoses of South Primorje. Nauka, Moscow, 5 pp. [In Russian].
- Martinovský J, Roháček J (1993) First records of *Synneuron annulipes* Lundström (Synneuridae) and *Mesaxymyia kerteszi* (Duda) (Axymyiidae) from Slovakia, with notes on their taxonomy and biology (Diptera). Časopis Slezskeho Zemskeho Muzea sér. A - Vědy Přírodní 42: 73-78.

- Matile L (1983) Notes taxinomiques et chorologiques sur les Gnoristini Paléarctiques (Diptera, Mycetophilidae). Annales de la Société entomologique de France (N.S.) 19 (4): 427-432.
- Økland B (1999) New rearing records of forest-dwelling Diptera . International Journal of Dipterological Reasearch 10: 143-146.
- Oosterbroek P (2017) Catalogue of the Craneflies of the World (Insecta, Diptera, Nematocera, Tipuloidea). http://ccw.naturalis.nl/
- Penttinen J, Ilmonen J, Jakovlev J, Salmela J, Kuusela K, Paasivirta L (2010) Thread-horned flies Diptera: Nematocera . The 2010 Red List of Finnish Species. Ympäristöministeriö & Suomen ympäristökeskus, Helsinki, 13 pp.
- Plassmann E (1980) Pilzmücken aus Messaure in Sweden. III. Lichtfallenfänge (Insecta: Diptera Mycetophilidae). Senckenbergiana biologica 60 (3/4): 175-189.
- Podenas S, Gelhaus J (2007) Identification keys for Limoniinae (Diptera, Limoniidae) of Mongolia and adjacent territories. Spausdino Vilniaus Universiteto Leidukla, Vilnius, 85 pp.
- Polevoi A, Salmela J (2014) New data on the distribution of *Limonia badia* Walker and *Gnophomyia acheron* Alexander (Diptera, Limoniidae) in Eastern Fennoscandia. Transactions of the Karelian Research Centre ofthe Russian Academy of Sciences, Series Biogeography (2)168-170.
- Polevoi AV, Pilipenko VE (2016) The first record of *Tipula apicispina* and *Tipula stenostyla* (Diptera, Tipulidae) from Russian Karelia with new data on their bionomics. Zoosystematica Rossica 25: 380-386. URL: https://www.zin.ru/journals/zsr/content/2016/zr_2016_25_2_Polevoi.pdf
- Polevoi AV, Barkalov AV (2017) Fungus gnats (Diptera: Bolitophilidae, Diadocidiidae, Keroplatidae, Mycetophilidae) of the lower course of Anadyr River, Chukotskii Autonomnyi Okrug, Russia. Euroasian Entomological Journal 16: 119-128.
- Polevoi AV, Nikitsky NB, Mandelshtam MY, Humala AE (2017) On the insect fauna of dead wood at the early stage of decay. Izvestia Sankt-Peterburgskogo Lesotehniceskogo Universiteta 220: 33-45. [In Russian].
- Rotheray GE, Horsfield D (2013) Development sites and early stages of eleven species of Clusiidae (Diptera) occurring in Europe. Zootaxa 3619 (4): 401-427. https://doi.org/10.11646/zootaxa.3619.4.1
- Rudzinski H, Ševčík J (2012) Fungus gnats (Diptera: Sciaroidea) of the Gemer region (Central Slovakia): Part 3 – Sciaridae . Časopis Slezskeho Zemskeho Muzea série A 61: 143-157. https://doi.org/10.2478/v10210-012-0015-1
- Ševčík J (2006) Diptera associated with fungi in the Czech and Slovak Republics. Slezské Zemské Muzeum Opava 55: 1-84.
- Shin S, Menzel F, Lee H, Lee S (2014) Review of the genus *Zygoneura* Meigen (Diptera: Sciaridae) in Korea, with an updated checklist of the World species. Journal of Asia-Pacific Entomology 17 (3): 561-567. https://doi.org/10.1016/j.aspen.2014.05.004
- Shorohova E, Kapitsa E, Kazartsev I, Romashkin I, Polevoi A, Kushnevskaya H (2016) Tree species traits are the predominant control on the decomposition rate of tree log bark in a mesic old-growth boreal forest. Forest Ecology and Management 377: 36-45. https://doi.org/10.1016/j.foreco.2016.06.036
- Siitonen J, Martikainen P, Kaila L, Mannerkoski I, Rassi P, Rutanen I (1996) New faunistic records of saproxylic Coleoptera, Diptera, Heteroptera, Homoptera and Lepidoptera from the Republic of Karelia, Russia. Entomologica Fennica 7: 69-76.

- Ståhls G, Kahanpää J (2006) New data on Platypezidae and Opetiidae (Diptera) of Finland. Sahlbergia 11: 1-6.
- Starý J (1974) Bemerkungen zu einigen wenig bekannten Limoniinen aus der Tschechoslowakei (Tipulidae, Diptera). Folia Facultatis Scientiarum Naturalium Universitatis Purkynianae Brunensis 15: 13-22.
- Starý J, Salmela J (2004) Redescription and biology of *Limonia badia* (Walker) (Diptera: Limoniidae). Entomologica Fennica 15: 41-47.
- Tkoč M, Barták M (2013) Flat-footed flies (Diptera: Platypezidae and Opetiidae) of Vráž nr Písek (Czech Republic). In: Kubík Š, Barták M (Eds) Workshop on Biodiversity, Jevany. Česká zemědělská univerzita v Praze, Praha, 7 pp.
- Tkoč M, Roháček J (2014) Diversity, distribution and biology of Romanian flat-footed flies (Diptera, Opetiidae and Platypezidae) with taxonomic notes on Callomyia saibhira Chandler. ZooKeys 459: 95-118. https://doi.org/10.3897/zookeys.459.8376
- Wiedenska J (2007) Sygaczowate. Limoniidae . In: Bogdanowicz W, Chudzicka E, Pilipiuk I, Skibinska E (Eds) Fauna of Poland. Characteristics and checklist of species, Part 2. Volume 2. Muzeum i Instytut Zoologii PAN, Warszawa, 4 pp. [In Polish].
- Yakovlev E, Scherbakov A, Polevoi A, Humala A (2000) Insect fauna of Paanajärvi National Park and proposed Kalevala National Park with particular emphasis on saproxylic Coleoptera, Diptera and Hymenoptera . In: Heikkilä R, Heikkilä M, Polevoi A, Yakovlev E (Eds) Biodiversity of old-growth forests and its conservation in the northwestern Russia. North Ostrobothnia Regional Environmental Centre, Oulu, 54 pp.
- Yakovlev EB (1988) Insect infestation of edible mushrooms in Soviet South Karelia and bioecological characteristics of the pests. Acta Botanica Fennica 136: 99-103.
- Yakovlev EB (1993) Production of macrofungi and the structure of dipterous communities of young pine and aspen forests in southern Karelia. Acta Botanica Fennica 149: 1-6.
- Yakovlev EB (1995) Species diversity and abundance of fungivorous Diptera in forest and city parks of Russian Karelia. International Journal of Dipterological Reasearch 6 (4): 335-362.

Supplementary material

Suppl. material 1: The list of Diptera species collected with trunk emergence traps

doi

Authors: Alexei Polevoi
Data type: occurrences
Brief description: The list of species and number of collected specimens.
Filename: species_collected.xls - Download file (40.00 kb)